ERIC Document Resume	See Instruction Sheet	DATE OF RESUME	DATE RECEIVED

A. PUBLICATION DATA

1a. ERIC NUMBER	2. ORIGINATOR CONTROL NO(S).	3. IDENTIFICATION NO.
ED001123	Na	CR 1382

DO NOT WRITE IN SPACE BELOW

4. AUTHOR(S):
Blatt, Sidney J.

MICROFILM COPY AVAILABLE
YES [X] NO [ ]

5. TITLE OF DOCUMENT ABSTRACTED:
Effects of Test Anxiety and Instructional Context on Problem Solving

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YES [ ] NO [ ]

6. PUBLICATION TITLE:
NA

TYPE OF REPORT
PROPOSAL [ ]
IN-PROGRESS [ ]
FINAL [X]
FOLLOW-UP [ ]

7. EDITOR(S):
NA

8. PLACE OF ORIGIN
ORG. Yale University
ST. New Haven, Conn.
CITY, STATE

OTHER ERIC REFERENCES:

9. PUBLISHER OR SOURCE Cooperative Research Program, Office of Education, Dept. of Health, Education, & Welfare, Wash., D.C.

TELE. EXT.
INST/LOC CODE

ERIC SATELLITE CODE

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
NA	NA	63	70

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR
report

16. INDEXING TERMS (6-12)

		playful context	atmosphere	
		learning		
problem-solving	efficiency	anxiety		
test anxiety	instructional context	testing		

17. ABSTRACT (MAX. 250 WORDS)

The effects of anxiety or cognitive process has been an area of extensive research. Considerable evidence has indicated that high anxious subjects are inferior to low anxious subjects on complex cognitive tasks. Another factor which may influence the effects of anxiety is the conditions under which a task is presented. Recent research has suggested that a playful atmosphere may facilitate the performance of high anxious subjects.

The purpose of this study was to study the effect of a playful condition, as compared to neutral and evaluative conditions, on the problem-solving performance of high and low anxious subjects. An equal number of high and low anxious subjects were chosen from a group of college students. The John - Rimoldi (problem-solving apparatus) was used as the problem-solving task.

The results of the study supported the hypothesis that high anxious subjects would show less efficiency. The high anxious subjects were not affected, however, by variations in instruction. The primary differences between high and low anxious subjects occured in the initial phase of the problem-solving process. Although problems were of varying degrees of complexity, it was the initial adoption to a situation or to a new problem that seemed to present the major difficulty to a high anxious subject. His efficiency was increased more by familiarity with the situation and with the task than by any variations of instructions or complexity.

ERIC No.	18. SOURCE OF ABSTRACT		
	C. FUNDING DATA		
	19. SUPPORTING ORGANIZATION	20. DIVISION OR DEPT.	21. CONTRACT NO. / PROJECT NO.
		22. TOTAL COST OF PROJECT	
		23. DURATION OF PROJECT	U.S. Department of Health, Education, and Welfare Office of Education

ERIC F.— 1

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CPR NO. 1382

BLATT

EFFECTS OF TEST ANXIETY AND INSTRUCTIONAL CONTEXT ON PROBLEM SOLVING

COOPERATIVE RESEARCH PROJECT NO. 1382

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EFFECTS OF TEST ANXIETY AND INSTRUCTIONAL CONTEXT ON PROBLEM SOLVING

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New Haven, Connecticut

1963

The research reported herein was supported by the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education, and Welfare.

[1] A Fellow of the Foundations' Fund for Research in Psychiatry.

[2] The author is indebted to Dr. Seymour Sarason for his comments during this research and for providing funds for a pilot study.

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Anxiety is generally considered as a constraining and constricting force which reduces an individual's flexibility and freedom to explore and assess aspects of a novel situation. The effects of anxiety on cognitive processes has been an area of extensive research activities and considerable evidence has indicated that high anxious subjects are inferior to low anxious subjects on complex cognitive tasks (Montague, 1953; Raymond, 1953; Taylor and Spence, 1952; Wiggins, 1957; Sarason and Mandler, 1952; Waite, Sarason, Lighthall and Davidson, 1958). It has been suggested that the decrement produced by anxiety increases with the complexity of the task (Farber, 1953). However, other investigators (Axelrod, Cowen and Heilizer, 1956; Baltz and Hoehn, 1957; Statts, 1957; Maltzman, Eisman and Brooks, 1956; Ruebush, 1960; and Van Buskirk, 1961) have not found significant differences due to anxiety on some complex tasks and it appears that the relationship between anxiety and cognitive efficiency is far from a simple one and is influenced by many factors in addition to the level of complexity of the task.

One of the factors which may influence the effects of anxiety on cognitive functioning is the conditions under which a cognitive task is presented. Though there has been extensive research on the effects of different types of stress on cognition, there have been relatively few studies which have simultaneously varied both the level of anxiety and the type of stress, in order to examine .. the interacting effects on cognitive efficiency. Graff (1957) found that failure stress improved the performance of high anxious subjects while approval disrupted their performance. Travers,

Martin and Post (1955) present equivocal findings; ego stress (loss of self esteem) in one study facilitated high anxious Ss, but in a subsequent study with similar Ss the same condition was found to interfere with functioning. Sarason (1961) found that personal threat was disruptive to performance of high anxious subjects, but with reassurance, high anxious subjects were significantly better than other groups. Not only does reassurance seem to facilitate high anxious subjects, but as indicated in his earlier research (Sarason, 1958) it seems to lower the motivational level and the performance of low anxious subjects.

In addition to situational factors, the effects of anxiety on complex cognitive processes may also be dependent upon the features of the cognitive task other than the level of complexity. Ruebush (1962) for example, reports that anxiety relates positively to the performance on the Witkin Embedded Figure test, a task which is aided by caution—a characteristic of high anxious subjects. Lighthall, Ruebush, Sarason and Zweibelson (1959) found that high anxious children did quite well on a test that had a game-like appearance, the Davis-Eells Tests, but that they did quite poorly on the Otis Intelligence Scale. Though the Davis-Eells was presented as a test, its playful, game-like quality seemed to reduce the negative effect of test anxiety. More recently, Van Buskirk (1961) found no differences between high anxious subjects and low anxious Ss on tasks of logical deduction. Ss, however, were given cash bonuses for superior performance, thus changing a usual testing situation into a more game-like atmosphere. The results of Lighthall, et al. (1959) and Van Buskirk (1961) suggest that a playful atmosphere, either in the

nature of the task or in the conditions under which it is presented, may facilitate the performance of high anxious subjects. Schactel (1961) discusses the role of play in the development of thought and seems to offer considerable insight into the difficulties that high anxious Ss experience in cognitive tasks and how a playful situation or a game-like problem might facilitate their functioning:

> ... "Only thought which is sufficiently free from urgent needs or fears can contemplate its objects fully and recognize it in relative independence of the thinker's needs and fears--that is, something objective. In thinking about a problem, one is usually successful only if one does not press too hard for solution; that is, one is more likely to be successful if the thought is truly object centered, free to contemplate the object from all sides, than if the thought is goal centered under the pressure of having to produce a solution immediately." (Schactel, 1961)

Considering the role that play may have in the development of thought and the suggestions in recent research that a playful atmosphere or game-like problems facilitate the performance of high anxious subjects, it seems important that the role of play in cognitive efficiency be more fully studied. The purpose of the present research was to attempt to establish playful conditions and to study the effects of this condition, as compared to neutral and evaluative conditions, on the problem solving performance of high and low anxious subjects. In consideration of the theory and research summarized above, the following hypotheses were the focus of the present study:

1. Anxiety will relate negatively to problem solving efficiency on a complex logical task.

2. The performance of high anxious subjects should be more affected by instructional variation than low anxious Ss.

3. The negative relationship between test anxiety and problem solving efficiency will be most marked under evaluative conditions.

4. Instructions designed to foster playful exploration will facilitate the problem solving efficiency of high anxious subjects and therefore this level of efficiency will not be significantly different than the problem solving efficiency of low anxious subjects in this condition.

In addition to studying the interaction of playful conditions and anxiety on problem solving efficiency, a second major purpose of the study was to attempt to specify what phases or aspects of the problem solving process were most vulnerable to the disruptive effects of anxiety. The research to date suggests that anxiety has a general disruptive effect on complex thought but little data is available about how and in what ways anxiety interferes with cognitive efficiency. By examining the relationship between anxiety and various aspects of the problem solving process, further understanding might be obtained about the effects that anxiety has on complex thought.

The John-Rimoldi Problem Solving (PSI) Apparatus (John, 1957, Blatt & Stein, 1959) was used as the problem solving task in the present study. In addition to the demonstrated validity of the PSI apparatus as an effective measure of problem solving efficiency it offers a complete record of the steps of the process through which solution is achieved. Since test anxiety is considered to have its most detrimental effect in the initial adaptation to a situation (Sarason, 1963), it was expected that anxiety would be most clearly related to the efficiency of complex thought in both the initial problem of the series of problems and in the initial phase of each problem.

5. The difference in level of efficiency of high anxious and

low anxious Ss would be most apparent in the initial problem of the experiment.

6. Within each problem, anxiety would most clearly relate to inefficiency in the initial phase of the problem.

PROCEDURE

On the John-Rimoldi Problem Solving and Information (PSI) Apparatus, the problem solving task of the present study, the subject is presented with a panel containing a circular array of nine lights, plus a center light. Next to each of the nine outer lights there is a button, which, when pressed in the correct time cycle,[3] lights up its corresponding light. Some of the lights are interrelated, so that when button A is pressed, light A comes on, followed in the next time cycle (three seconds later) by light B, with which it was related. The existence of a relationship between the lights is indicated by arrows on a removable disc, and there are different discs for each problem. An arrow indicates one of three types of relationships:

1. A direct one-to-one effector--such that the activation of "A" causes "B" to light in the next time interval.

2. A facilitory or combiner effect--such that "A" plus another light "X", which also has an arrow going to "B", can light "B" if, and only if, "A" and "X" are lit simultaneously.

3. A blocking effect--such that "A" prevents "X" (which has an arrow to "B") from lighting "B", i.e., "X" can light "B" only if "A" has not been activated. The subject is instructed about the types of relationships that exist on the apparatus, but he is left to discover or infer the specific relationships within each problem.

The center light has no activating button, and it is the task in each problem to discover the one correct sequence of the three

---

[3]There are two time cycles, indicated by a light in the upper left hand corner of the apparatus; each time cycle is of three seconds' duration. The position of the light is indicated in Figure 1.

buttons at the bottom of the circle that will light the center light. (On the apparatus these buttons are colored red to distinguish them from the others, which are colored black.) The subject may use the buttons (red or black) as he wishes to discover relationships, but the final solution is to light the center light by using only the three red buttons.

To clarify the characteristics of the problem solving apparatus, and to indicate their relationships to the problem solving process, the disc for the demonstration problem (see Figure 1) will be discussed. Included here are the instructions given to the subject at the beginning of the experiment.

In the demonstration problem, the subject can obtain the following information directly from the disc:

a. The center light will be lit if one or some combination of Lights I, II, and III are lit.

b. Light VII lights I.

c. Light IV lights VIII and IX.

d. Light V lights III.

Prior to pressing any of the buttons, the subject may also make one inference: Light IV will light VII. This is deduced from the fact that Lights VIII and IX together will light VII because neither VIII nor IX can be effected by any light other than IV. When IV is pressed, it will light VIII and IX which will light VII. Not all subjects seek out or obtain all of the above information before pressing any of the buttons. Some learn these relationships by "experience," i.e., by pressing the buttons.

In this experiment, the efficient subject is defined as the one who asks the smallest number of unnecessary questions. These unnecessary questions fall into three categories--redundant, non-abstract, and unique. Examples of such questions appear in the discussion that follows and they will be defined later.

To relate the model of the problem solving process in the demonstration problem, let us assume that the subject decides to learn the relationship between Lights I, II, and III to the center light. Whether he decides to press only one of these three lights or a pair of them depends on factors--chance or individual--that are unclear at present. If he presses any one of these three buttons by itself, it will not light the center light. If he presses I and II together, he will light the center light and since he knows that there is only one correct combination that can have this effect, he can infer that III is an inhibitor. He does not have to press III to learn this; if he does, he has asked what we have termed an unnecessary, non-abstract question. Another subject may press I and III together and follow this by pressing II and III together. Both are necessary questions although in neither case will he light the center light. Finally, he may also press Lights I and II.

From this point on, the subject can infer all the information necessary to solve this problem from the disc and without pressing any additional buttons.

It should be clear to the subject that to solve the problem, he has only to activate Lights I and II by pressing some sequence of the three red buttons, and that he should avoid lighting III. Suppose he decides to work on how to light I. From the information on the disc,

the efficient subject infers that he can light I by pressing IV; thus he has learned one of the critical buttons. Thereafter, any question he asks about how to light I is an unnecessary and inefficient question.

Let us now turn to Light II. Two arrows converge on II; one from V and the other from VI. Since V has an arrow going to III and since there is no way of inhibiting V from lighting III, the subject can infer that if he lights V, he will activate II and III. Consequently, VI is the only logical button for lighting II. Again, the subject can infer this and any further question about this sequence is unnecessary.

At this point, the subject has all the necessary and sufficient information to light the center light. He knows that Lights I and II must be activated simultaneously to light the center light. He knows that I will follow if he presses IV, and II will follow if he presses VI. Up to this point, the subject's behavior is described as analytic, for he has been concerned solely with the analysis of one-to-one relationships. He must now integrate this information and coordinate the interactions of the various lights. Since three steps precede activation of Light I and only one step precedes activation of Light II, and since both I and II must be lit simultaneously to activate the center light, the sequence leading to Light I must be initiated two cycles before the II sequence is started. The second part of Figure 1 shows the solution schematically. Ideally, there is no elaboration beyond the point of necessary and sufficient information and synthesis should consist of the single step involving temporal coordination of the Light I and the Light II sequences.

Such ideal behavior, however, is not typical; even if subjects were aware of the fact that they have obtained the necessary and sufficient information, they might have difficulty in coordinating them in time. Ordinarily, some time and unnecessary questions intervene between the end of the initial phase and the final solution of the problem. Subjects also ask unnecessary questions throughout the problem solving process. They confirm information; they forget or become confused about the sequence of elements in the various relationships; they overlook the importance of the time cycles, etc. Consequently, they repeat questions that have already been asked or they try new combinations of button presses that yield no new and direct information. Both these are types of unnecessary questions. The former are called redundant, and the latter, unique questions.

The experimental problem, not presented here, is much more complex. It involves the gathering of a larger amount of information and its solution requires the integration of a larger number of elements. But its essential details have all been illustrated in the demonstration problem.

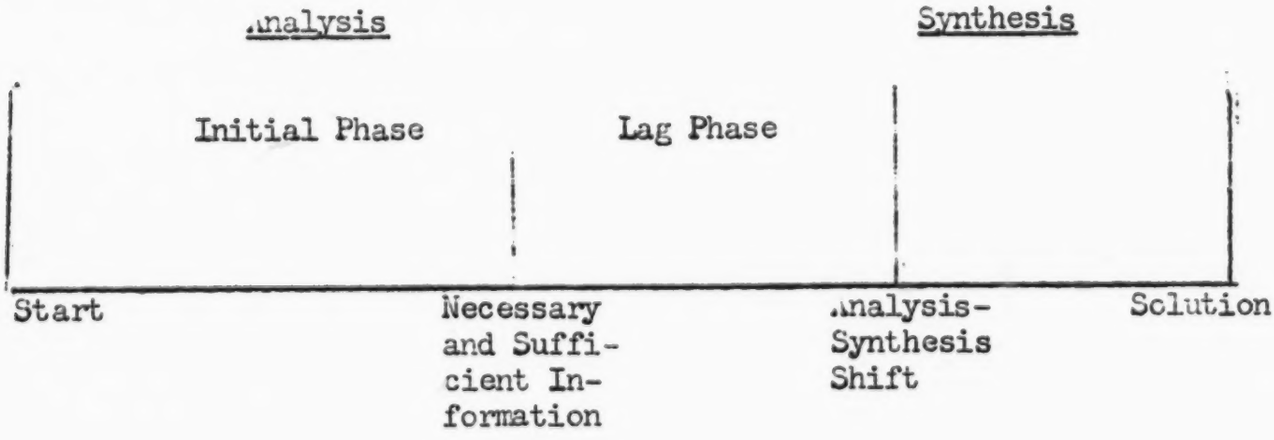
The subject is seated in front of the apparatus. The lights, the activating buttons, the relationships indicated by the arrows on the disc of the demonstration problem are explained; the subject is told that while he is free to use any button in his search for the solution, his task is to find a way of lighting the center light by pressing the one sequence of the three bottom buttons that will solve the problem. The demonstration problem is followed by a practice problem. When all questions have been answered, the experimental problem is presented and the subject is told to proceed as he wishes,

and to solve the problem with as few button presses and in as short a time as possible. Each of the subject's presses is automatically recorded and the results to be reported are based on the protocols of the responses. Due to the complexity of the problem, the subject is permitted to take notes. Analysis of these notes indicates that they serve primarily as a memory device and they are not included in the analysis of the results.

Thus on the apparatus the subject must press buttons to gather information about the logical relationships within the problem. He must also press buttons when testing his various attempts to integrate this information. All button presses are automatically recorded and a complete record of the problem solving performance is obtained without interfering with the behavior of the subject. Since the experimenter knows the entire informational content of the problem, the problem solving process of the subject can be reconstructed sequentially, step by step. In this sequential analysis of responses it is possible to identify for each subject which responses were necessary for solution and which were not; the number of unnecessary questions asked while solving the problem is the measure of efficiency of the problem solving. Also in the sequential analysis of the responses, it is possible to identify the point at which the subject has available all the necessary and sufficient information needed to solve the problem. Also identifiable is the analysis-synthesis shift point which is the point which best meets the following two conditions: a) the predominance of the analytic questions have already been asked, and b) the predominance of synthesis questions still remain to be asked. Analytic questions are defined as those in which

there is one cause and one effect, or one cause and multiple effects, or multiple causes with a single effect. The basic definition of an analytic question is where one side of the question is unity and the question is asked to find the constituent parts of that unity (Duncker, 1945). Synthesis questions are those in which there are multiple causes and multiple effects, where the question is an attempt to bring together and integrate information. The analysis-synthesis shift point is located where the difference between the per cent of analytic questions asked and the per cent of synthesis questions asked is maximum ($a/A - s/S$ = maximum). ("a" and "s" are respectively the number of preceding analytic and synthetic questions.) This value also indicates the extent of the separation between the two phases. For example, if all the analytic questions had already occurred before a specific point, ($a/A = 100$) and all the synthesis questions were still to be asked ($s/S = 0$), then the separation of the two phases would be perfect or 100. A less clear separation between the two phases would be indicated by a reduction of this maximum value.

The points of necessary and sufficient information and the analysis-synthesis shift point delineate three phases of the problem solving process as illustrated schematically below:



The initial phase extends from the beginning of the problem to the point at which the subject has available implicitly the necessary and sufficient information for solution. This is followed by the lag phase, where the subject gathers additional information prior to shifting from analysis to synthesis. In the synthesis phase the subject's behavior reflects primary concern with coordinating the information he has obtained. Using this model of the problem solving process it is possible to specify the degree of inefficiency within each of the phases as well as the degree of inefficiency for the total problem.

In addition to specifying the degree of inefficiency in each phase of the problem solving process, the characteristics or type of inefficiency can be specified. Unnecessary or inefficient questions are of three types:

1. Non-abstract: Questions that have never been asked before but which yield information that could have been inferred from prior information. The number of non-abstract questions that a subject can ask is defined by the characteristics of the problem and the approach taken by the subject. At a maximum, there are only eight non-abstract questions that could be asked in the experimental problem.

2. Redundant: Questions that haven been asked before.

3. Unique: Questions that have not been asked previously and which do not convey new and direct information.

The number of unique questions in a problem solving performance is a paradoxical measure, however, because it represents both a type of inefficiency as well as attempts at cognitive restructuring. By comparing number of unique questions in a problem solving performance, the estimates of the capacity to ask questions which restructure the

cognitive field is confounded with the level of efficiency of the performance. A more adequate evaluation of the relative capacity for restructuring is an estimate of the extent to which a subject's inefficiency is devoted to questions which reflect restructuring of the cognitive field as compared to non-productive types of inefficient questions. A more meaningful measure of the capacity for restructuring, therefore, would be the ratio of unique to redundant questions. Non-abstract questions are not included in this measure because there is only a very limited number of non-abstract questions that can be asked. There are no limits, however, on the number of unique or redundant questions that a subject can ask while solving a problem. The unique to redundant ratio therefore offers a meaningful statement about the relative composition of a subject's inefficiency, independent of the level of efficiency of the performance.

Subjects:

Approximately three hundred male undergraduate college students in introductory psychology sections were given the Sarason-Mandler Test Anxiety Scale (1952) and the upper and lower 10% of the distribution were selected for study. Though it might have been desirable to match groups for intelligence, the interaction of test anxiety and intelligence test performance makes this a questionable procedure.

There were no significant differences between the college grades of the high and low anxious groups in this study, nor were there any significant differences between the two groups in their predicted college average as established by the University Examiner's Office. The low anxious group did have a significantly higher ($<.05$) Mathematics score on the College Entrance Boards, but there was no

significant difference between the two groups on the Verbal section of this test.

When contacted to participate in the subsequent part of the experiment, Ss were told that they were part of a random sample of students selected for a study of problem solving. All sixty Ss agreed to participate and they were divided into a 2 x 3 design of high and low anxiety and three types of problem solving instructions: evaluative, neutral, and playful exploration.

The evaluative instructions emphasized the scientific precision of the problem solving apparatus in the study of creativity and that the design of the experiment was to compare Yale students with national norms. Ss were told that their performance would be recorded by an observer behind a one-way observation window. The neutral groups were given the instructions for the problem solving task with no attempt to place it in any specific context. The playful exploration groups were told that the problem solving apparatus was a gadget that a few people around campus had just built. We had a great deal of fun building it, but did not know if it had any value and therefore wanted a group of students to play around with it, try to solve some problems and to tell us what they thought about it. In both the neutral and playful conditions the one-way observation mirrors were covered by curtains.

The experimenter was present during Problem 1, since it is the problem on which instructions are given. During Problems 2 and 3, however, the experimenter left the room and subjects were told that the experimenter was in another office down the hall and that the subject should call for the experimenter when he was finished with the problem. The only other time the experimenter came to the experimental room was when a subject exceeded the established time limit.

In administering the problem solving task the experimenter was given the subjects' names and the instructional group to which they had been randomly assigned, but was not given any information about their anxiety score. All subjects were studied individually on the John-Rimoldi PSI, and given three standard problems (Blatt, 1961). The first of three problems is relatively simple and is used to demonstrate the apparatus. The second problem, though somewhat more complex than the first, is relatively easy and it is used to insure the experimenter that the instructions have been fully understood. The third problem is the experimental problem and is considerably more complex than the first two problems. Ss' level of problem solving efficiency was obtained for all three problems. In the second and third problems the degree of efficiency for each of the phases of the problem solving process was obtained as well as the nature and characteristics of the total inefficiency.

RESULTS

I. Level of Efficiency:

The present study was designed with two levels of anxiety and three instruction conditions and it was planned to utilize analysis of variance to test main effects and their interactions. The distribution of the major measure, efficiency in the experimental problem, however, was markedly skewed. A relatively large number of subjects (15 of 60) failed to solve the problem and there was no effective way to discriminate the relative efficiency of these subjects. There were no transformation procedures which would order the data so they could approximate a normal distribution and therefore, analysis of variance procedures could not be used to analyze the data. Instead, the data were converted to ranks and non-parametric procedures (Mann-Whitney U test and the Wallis-Kruskil H Test) were used to test the main effects of anxiety and instruction conditions. Some interactions were tested by converting the U values to z scores and contrasting z scores according to a procedure developed by Guttmann (Chapin, 1947) and later elaborated by Stauffer (Lindzey, 1954). Since the primary focus of the study was to examine the effect of play instructions on problem solving, between condition comparisons were always made between play and each of the other two conditions.

Table 1 presents the problem solving efficiency of high and low anxious subjects in each of the three types of instructions during the experimental problem. High anxious subjects were significantly less efficient than low anxious subjects ($p = .05$) and this difference was in the same direction in all three types of instructions. Though there were no significant between condition effects, either over-all

or within groups, some interesting trends did occur. High and low anxious subjects were most similar under play instructions and the difference in level of efficiency between the two groups seemed most marked in the neutral condition. It should also be noted that the within group comparisons were in the expected direction; high anxious subjects were most efficient in the play condition as compared to the other two conditions, but this difference did not reach statistical significance. Within the low anxious groups, subjects in the play condition, however, were less efficient than those low anxious subjects in the other two conditions.

Table 2 presents the efficiency scores for Problem 2, the practice problem. Again, the only finding which approached statistical significance was the total difference between high anxious and low anxious subjects. The play condition again appeared to facilitate the performance of high anxious subjects (as well as low anxious subjects) but not to a statistically significant degree.

Problem 1 was the demonstration problem used in the instructions. After the problem solving apparatus had been explained to the subject and all the steps to solution for the demonstration problem were illustrated, subjects were asked to integrate the information and solve the problem. The number of attempts necessary for arriving at the solution was the measure of efficiency for the first problem.[4]

Table 3 presents the results for Problem 1 and once again the high anxious subjects were significantly less efficient than low anxious subjects. In contrast to the trends on Problems 2 and 3,

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[4]This is the only measure available from the demonstration problem and therefore in subsequent analyses, only Problems 2 and 3 will be presented.

Table 1

Efficiency in Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	73.0	43.0	38.5	50.0
High Anxious	76.5	90.5	115.5	88.0
Total	76.0	65.0	61.5	

	z	p
Anxiety Effect	1.62	.05
Play	.42	NS
Evaluative	.76	NS
Neutral	1.50	.07
Condition Effect (H test)	.48	NS
Within Groups:		
Low Anxious		
total (H test)	2.60	NS
play-evaluative	.53	NS
play-neutral	.72	NS
High Anxious		
total (H test)	1.80	NS
play-evaluative	.15	NS
play-neutral	-.19	NS
Interaction:		
play-evaluative	.27	NS
play-neutral	.64	NS

Table 2

Efficiency in Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	26.0	30.0	34.5	29.5
High Anxious	30.0	33.5	40.0	40.0
Total	28.5	31.0	38.5	

	z	p
Anxiety Effect	1.36	.09
Play	1.06	NS
Evaluative	.42	NS
Neutral	.75	NS
Condition Effect (H test)	1.58	NS
Within Groups:		
Low Anxious		
total (H test)	.21	NS
play-evaluative	-.08	NS
play-neutral	-.34	NS
High Anxious		
total (H test)	1.66	NS
play-evaluative	.91	NS
play-neutral	.15	NS
Interaction:		
play-evaluative	.69	NS
play-neutral	.35	NS

Table 3

Efficiency in Problem 1

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	0.5	0	2.0	1.0
High Anxious	4.5	2.0	2.5	3.0
Total	2.5	2.0	2.0	

	z	p
Anxiety Effect	2.69	.005
Play	2.83	.002
Evaluative	.83	NS
Neutral	.87	NS
Condition Effect (H test)	1.48	NS
Within Groups:		
Low Anxious		
total (H test)	1.29	NS
play-evaluative	-.15	NS
play-neutral	-1.21	NS
High Anxious		
total (H test)	3.65	NS
play-evaluative	1.85	.03
play-neutral	.87	NS
Interaction:		
play-evaluative	1.41	.08
play-neutral	1.47	.07

the performance of high anxious subjects did not seem to be facilitated by the play condition. Within the high anxious group on Problem 1, the subjects in the play condition were significantly less efficient than the high anxious subjects in the evaluative condition.

In summary, high anxious subjects were significantly less efficient than low anxious subjects on all three problems in the present study. Though it was not possible to test statistically whether the difference between high anxious and low anxious subjects was significantly greater on Problem 1 than on Problem 3, the data clearly indicated a trend in this direction. Since Problem 1 was by far the easiest problem in the series, this trend suggests that it was the initial adjustment to the experiment, rather than the complexity of the problem, which presented difficulty for high anxious subjects. This hypothesis will be examined in more detail later when the relative efficiency of high and low anxious Ss is compared in each of the three phases of the problem solving process.

Generally, there were no statistically significant total between condition effects or condition effects within anxiety groups. There was some suggestion that the play condition facilitated the performance of high anxious subjects on the later (and more difficult) problems and though this trend appeared in both Problems 2 and 3, it did not reach statistical significance. Play conditions in the initial problem (Problem 1), however, had a statistically significant disruptive effect on high anxious subjects.

Time:

In addition to the number of unnecessary questions, time to solution can also be used as a measure of efficiency. As indicated in an

earlier paper (Blatt & Stein, 1959), however, time is an external metric which only approximates the more internal metric, number of unnecessary questions. Tables 4 and 5 present the results of time to solution of Problems 3 and 2. In the experimental problem (3), high anxious subjects were significantly slower in arriving at solution than low anxious subjects. This difference in time to solution approached significance in both the evaluative and neutral conditions but not in the play condition. This finding closely parallels the results with efficiency and tends to indicate that there was an over-all greater efficiency for low anxious subjects, but this difference between low anxious and high anxious subjects diminished somewhat when the problem was presented under play conditions.

As seen in Table 5, there were no significant differences in time to solution for Problem 2. High anxious and low anxious groups were not significantly different in time to solution for this problem and there were no significant condition effects.

II. Characteristics of Inefficiency:

Earlier, two primary types of inefficient questions were specified: 1) Redundant questions: those which had been asked before, and 2) Unique questions: those which had not been asked before and which did not convey any new and direct information.

Table 6 presents the number of redundant questions asked in Problem 3 and the only significant finding that emerged was the greater number of redundant questions asked by high anxious subjects. Table 7 presents the number of redundant questions asked in Problem 2 and again, the only significant finding was the main effect of anxiety.

Table 4

Time to Solution in Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	22.30	29.75	22.85	25.10
High Anxious	26.83	41.53	44.13	36.40
Total	26.63	34.50	32.03	

	z	p
Anxiety Effect	2.25	.015
Play	1.06	NS
Evaluative	1.62	.05
Neutral	1.58	.06
Condition Effect (H test)	.38	NS
Within Groups:		
Low Anxious		
total (H test)	.24	NS
play-evaluative	-.30	NS
play-neutral	-.23	NS
High Anxious		
total (H test)	1.32	NS
play-evaluative	-.94	NS
play-neutral	-1.02	NS
Interaction:		
play-evaluative	.45	NS
play-neutral	.56	NS

Table 5

Time to Solution in Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	13.75	14.03	14.53	14.38
High Anxious	13.50	14.80	18.30	15.35
Total	13,60	14.08	16.43	

	z	p
Anxiety Effect	.69	NS
Play	.38	NS
Evaluative	.30	NS
Neutral	.45	NS
Condition Effect (H test)	1.84	NS
Within Groups:		
Low Anxious		
total (H test)	.38	NS
play-evaluative	-.08	NS
play-neutral	-.45	NS
High Anxious		
total (H test)	1.49	NS
play-evaluative	-.30	NS
play-neutral	-.90	NS
Interaction:		
play-evaluative	.27	NS
play-neutral	.32	NS

Table 6

Number of Redundant Questions in Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	36.5	24.5	23.5	26.0
High Anxious	40.5	59.0	71.5	52.5
Total	39.5	40.5	42.0	

	z	p
Anxiety Effect	1.68	.05
Play	1.02	NS
Evaluative	.75	NS
Neutral	1.17	NS
Condition Effect (H test)	.14	NS
Within Groups:		
Low Anxious		
total (H test)	.04	NS
play-evaluative	.08	NS
play-neutral	.26	NS
High Anxious		
total (H test)	.41	NS
play-evaluative	-.26	NS
play-neutral	-.23	NS
Interaction:		
play-evaluative	.13	NS
play-neutral	.35	NS

Table 7

Number of Redundant Questions in Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	18.0	10.0	26.5	16.0
High Anxious	21.5	22.0	44.5	31.5
Total	21.0	14.0	34.0	

	z	p
Anxiety Effect	1.91	.03
Play	1.28	.10
Evaluative	.87	NS
Neutral	1.06	NS
Condition Effect (H test)	2.64	NS
Within Groups:		
Low Anxious		
total (H test)	.64	NS
play-evaluative	.68	NS
play-neutral	-.45	NS
High Anxious		
total (H test)	2.06	NS
play-evaluative	1.09	NS
play-neutral	-.08	NS
Interaction:		
play-evaluative	.29	NS
play-neutral	.26	NS

There were no statistically significant between condition effects, though there were trends on both problems for high anxious subjects in the play condition to ask fewer redundant questions than high anxious subjects in the other two conditions.

Unique questions frequently represent a subject's attempt to reorganize and restructure the cognitive field. These are an interesting type of inefficiency, for though they are unnecessary questions, they may represent attempts at cognitive restructuring, a capacity frequently associated with cognitive efficiency. As seen in Table 8, there was a trend for high anxious subjects to ask a greater number of inefficient questions of this type. This trend was not supported by the results on Problem 2, where there was no essential difference between high anxious and low anxious subjects on this measure.

As discussed earlier, a more meaningful assessment of a subject's capacity for restructuring, independent of the level of efficiency, is the unique to redundant ratio. As presented in Table 10, there was a significant difference between high anxious and low anxious subjects on this measure in Problem 3. The inefficiency of high anxious subjects appeared to be comprised of a relatively higher degree of redundant questions than the inefficiency of low anxious subjects. This difference was not only significant over-all, but approached significance in both the play and evaluative conditions. There were no significant between condition effects on this measure for Problem 3, however, either in a total comparison or within groups.

These results are even more striking in Problem 2, where there was a highly significant difference between high anxious and low anxious subjects in the extent to which their inefficiency was comprised of

Table 8

Number of Unique Questions in Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	12.5	14.0	8.0	10.0
High Anxious	16.5	11.0	24.0	16.0
Total	15.0	12.5	12.5	

	z	p
Anxiety Effect	1.37	.09
Play	.64	NS
Evaluative	.11	NS
Neutral	1.47	.07
Condition Effect (H test)	.20	NS
Within Groups:		
Low Anxious		
total (H test)	.94	NS
play-evaluative	0	NS
play-neutral	.79	NS
High Anxious		
total (H test)	.56	NS
play-evaluative	.60	NS
play-neutral	-.26	NS
Interaction:		
play-evaluative	.43	NS
play-neutral	.75	NS

Table 9

Number of Unique Questions in Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	5.5	5.0	4.0	5.5
High Anxious	4.0	5.0	4.5	4.0
Total	4.5	5.0	4.5	

	z	p
Anxiety Effect	.13	NS
Play	.64	NS
Evaluative	.72	NS
Neutral	.23	NS
Condition Effect (H test)	.24	NS
Within Groups:		
Low Anxious		
total (H test)	.41	NS
play-evaluative	.60	NS
play-neutral	.30	NS
High Anxious		
total (H test)	.07	NS
play-evaluative	0	NS
play-neutral	-.19	NS
Interaction:		
play-evaluative	.42	NS
play-neutral	.35	NS

redundant rather than unique questions. This difference, as seen in Table 11, between high anxious groups was most significant in the play condition.

Though there was no statistically significant total between condition effect, there was a significant condition effect within the high anxious group. High anxious subjects in the evaluative condition appeared to have a smaller proportion of redundant questions than high anxious subjects in the play or neutral condition. There was also a significant play-evaluative interaction in Problem 2; the proportion of redundant questions decreased for low anxious subjects in the play condition as compared to the evaluative condition and the opposite effect occurred with high anxious subjects.

In summary, the significant differences in level of efficiency between high and low anxious subjects seemed to be primarily a function of the tendency for high anxious subjects to ask more redundant questions. Both on an absolute basis, and even when the degree of redundancy was compared to the number of unique inefficient questions, high anxious subjects had a significantly greater degree of redundancy than low anxious subjects. The types of instructions had no significant effect upon either the number of redundant questions or the number of unique questions that were asked by a subject. In Problem 2 the evaluative condition as compared to play and neutral conditions tended to reduce the relative level of redundancy of high anxious subjects.

III. Process Characteristics:

An additional purpose of the present research was to study the

Table 10

Unique/Redundant Ratio in Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	.407	.500	.263	.428
High Anxious	.299	.333	.289	.322
Total	.339	.408	.267	

	z	p
Anxiety Effect	2.14	.02
Play	1.51	.07
Evaluative	2.04	.02
Neutral	.08	NS
Condition Effect (H test)	2.17	NS
Within Groups:		
Low Anxious		
total (H test)	2.71	NS
play-evaluative	-.38	NS
play-neutral	1.47	.07
High Anxious		
total (H test)	.25	NS
play-evaluative	-.15	NS
play-neutral	.08	NS
Interaction:		
play-evaluative	.16	NS
play-neutral	1.09	NS

Table 11

Unique/Redundant Ratio in Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	.302	.265	.234	.272
High Anxious	.137	.204	.133	.173
Total	.191	.229	.181	

	z	p
Anxiety Effect	2.96	.002
Play	3.47	.0002
Evaluative	.30	NS
Neutral	1.17	NS
Condition Effect (H test)	2.67	NS
Within Groups:		
Low Anxious		
total (H test)	1.17	NS
play-evaluative	.72	NS
play-neutral	.94	NS
High Anxious		
total (H test)	7.32	.05
play-evaluative	-2.68	.01
play-neutral	.26	NS
Interaction:		
play-evaluative	2.40	.01
play-neutral	.48	NS

problem solving process of high and low anxious subjects and to identify the aspects of the process which appear to be most vulnerable to the effects of anxiety. The problem solving process has been conceptualized as consisting of three distinct phases: the initial phase where the subject gathers essential information about the problem, the lag phase which is a further gathering of information which ideally is not necessary for solution, and last, a synthesis phase where the information is integrated to obtain solution (Blatt & Stein, 1959).

Since test anxiety is considered to have its most detrimental effects in the initial adaptation to a problem (Sarason, 1963), it was expected that high anxious subjects would be significantly less efficient than low anxious subjects only in the initial phase of the problem solving process. The levels of efficiency in each of the three phases of problems were compared for high and low anxious subjects under the three different instruction conditions. Tables 12, 13, and 14 present the analyses for the three phases of Problem 3, the experimental problem, and Tables 15, 16, and 17 present these analyses for Problem 2.

As indicated in Table 12, there was no significant over-all difference between low anxious and high anxious subjects in the level of efficiency during the initial phase of the experimental problem. The two anxiety groups did differ significantly in the play condition, where high anxious subjects were significantly less efficient than low anxious subjects. There was a trend in the opposite direction, however, in the neutral and evaluative conditions where the high anxious group tended to be more efficient than the low anxious group. The significant interaction of the play-neutral comparison with anxiety level is seen in the

significant play-neutral difference in the low anxious group and in the near significant difference in the opposite direction in the high anxious group. Play appeared to facilitate the initial efficiency of low anxious subjects but not high anxious subjects. Though play instructions seemed to be somewhat facilitative for the total efficiency of high anxious subjects, it tended to reduce their efficiency in the initial phase of the problem solving process.

Table 13 presents the efficiency during the lag phase of Problem 3 and generally there appeared to be no significant differences in either main effects or in their interaction. Table 14 presents the level of efficiency during the synthesis phase of the experimental problem and the only difference in this phase that approached statistical significance was a tendency for low anxious subjects to be more efficient than high anxious subjects. Thus, during Problem 3, major differences between high and low anxious subjects, as well as differences due to condition effects, occurred during the initial phase of the problem solving process. Play conditions appeared to produce a significant facilitation of the efficiency of low anxious subjects but also tended to disrupt the initial efficiency of high anxious subjects.

Tables 15, 16, and 17 present the analyses of efficiency by phases for Problem 2. As indicated in Table 15, low anxious subjects were significantly more efficient than high anxious subjects in the initial phase. This difference was statistically significant when the total anxiety groups were considered and there were significant differences between the anxiety groups in two of the three conditions as well (in play and neutral instructions). Though there was no significant total between condition effect, there were significant condition

Table 12

Number of Unnecessary Questions in the Initial Phase of Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	4.0	5.5	11.5	6.5
High Anxious	9.5	3.5	5.5	6.0
Total	5.5	5.0	9.5	

	z	p
Anxiety Effect	.26	NS
Play	1.66	.05
Evaluative	.19	NS
Neutral	1.28	.10
Condition Effect (H test)	1.05	NS
Within Groups:		
Low Anxious		
total (H test)	3.48	NS
play-evaluative	-.57	NS
play-neutral	-1.74	.04
High Anxious		
total (H test)	1.74	NS
play-evaluative	1.02	NS
play-neutral	1.24	NS
Interaction:		
play-evaluative	1.12	NS
play-neutral	2.11	.02

Table 13

Number of Unnecessary Questions in the Lag Phase of Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	16.5	17.5	2.5	9.0
High Anxious	13.0	11.5	20.0	14.0
Total	16.0	14.5	8.5	

	z	p
Anxiety Effect	1.01	NS
Play	.23	NS
Evaluative	.11	NS
Neutral	1.06	NS
Condition Effect (H test)	.04	NS
Within Groups:		
Low Anxious		
total (H test)	1.66	NS
play-evaluative	.42	NS
play-neutral	1.36	.09
High Anxious		
total (H test)	1.43	NS
play-evaluative	-.08	NS
play-neutral	-1.06	NS
Interaction:		
play-evaluative	.34	NS
play-neutral	1.71	.05

Table 14

Number of Unnecessary Questions in the Synthesis Phase of Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	16.5	29.0	24.5	19.0
High Anxious	32.0	32.5	40.5	36.0
Total	27.5	32.5	32.5	

	z	p
Anxiety Effect	1.55	.06
Play	1.09	NS
Evaluative	1.06	NS
Neutral	.64	NS
Condition Effect (H test)	.15	NS
Within Groups:		
Low Anxious		
total (H test)	.11	NS
play-evaluative	-.08	NS
play-neutral	-.49	NS
High Anxious		
total (H test)	.10	NS
play-evaluative	.15	NS
play-neutral	.30	NS
Interaction:		
play-evaluative	.16	NS
play-neutral	.56	NS

effects within each anxiety group. Play instructions on Problem 2, as they did on Problem 3, tended to facilitate the performance of low anxious subjects. Within the high anxious group, the results obtained on Problem 2 were similar to the results found on Problem 3. Play instructions tended to reduce the initial efficiency of high anxious subjects and evaluative conditions tended to facilitate their performance during the initial phase.

Tables 16 and 17 present the efficiency scores during the lag and synthesis phases respectively. Findings for Problem 2 were similar to the results for Problem 3; the primary differences between anxiety groups and conditions were seen in the initial phase. There were no significant differences between the anxiety groups nor any significant conditions effects or interactions during the lag and the synthesis phases of Problem 2.

Summary:

In a comparison of the level of efficiency during the three phases of the problem solving process the primary difference between high and low anxious subjects occurred in the initial phase. It was also during the initial phase that the primary effects of instructional conditions were seen. The data indicated that anxiety groups did not differ significantly in the latter stages of the problem solving process, during the lag and synthesis phases. Also variations in instructions did not seem to have a significant effect during these later stages.

In the initial phase, high anxious subjects generally tended to be less efficient than low anxious subjects. Play conditions generally facilitated the initial efficiency of low anxious subjects but had a disruptive effect upon the efficiency of high anxious subjects.

Table 15

Number of Unnecessary Questions in the Initial Phase of Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	3.5	9.0	6.5	5.0
High Anxious	14.5	3.0	18.5	10.0
Total	8.0	4.5	9.0	

	z	p
Anxiety Effect	1.94	.03
Play	2.87	.002
Evaluative	1.06	NS
Neutral	1.77	.04
Condition Effect (H test)	3.68	NS
Within Groups:		
Low Anxious		
total (H test)	2.81	NS
play-evaluative	-1.40	.08
play-neutral	-1.47	.07
High Anxious		
total (H test)	7.98	.02
play-evaluative	2.49	.01
play-neutral	-.42	NS
Interaction:		
play-evaluative	2.75	.01
play-neutral	.75	NS

Table 16

Number of Unnecessary Questions in the Lag Phase of Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	9.5	4.0	3.0	4.5
High Anxious	1.5	11.5	0	6.0
Total	4.0	10.0	1.0	

	z	p
Anxiety Effect	.45	NS
Play	.53	NS
Evaluative	.30	NS
Neutral	.68	NS
Condition Effect (H test)	1.97	NS
Within Groups:		
Low Anxious		
total (H test)	.39	NS
play-evaluative	0	NS
play-neutral	.68	NS
High Anxious		
total (H test)	1.79	NS
play-evaluative	-1.17	NS
play-neutral	.53	NS
Interaction:		
play-evaluative	.83	NS
play-neutral	.11	NS

Table 17

Number of Unnecessary Questions in the Synthesis Phase of Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	11.0	5.5	10.5	10.0
High Anxious	21.0	6.5	14.0	14.0
Total	14.0	5.5	12.0	

	z	p
Anxiety Effect	1.15	NS
Play	1.32	.09
Evaluative	.42	NS
Neutral	.57	NS
Condition Effect (H test)	3.12	NS
Within Groups:		
Low Anxious		
total (H test)	1.46	NS
play-evaluative	1.32	.10
play-neutral	.04	NS
High Anxious		
total (H test)	1.81	NS
play-evaluative	.94	NS
play-neutral	.08	NS
Interaction:		
play-evaluative	.27	NS
play-neutral	.02	NS

Evaluative conditions, on the other hand, were the most facilitating condition for the performance of high anxious subjects during the initial phase of the problem solving process.

IV. Additional Process Dimensions:

Another aspect of the problem solving process is the degree to which the process is organized into analysis and synthesis phases. It will be recalled that analysis-synthesis shift point is located where the difference between the per cent of analytic questions asked and the per cent of synthesis questions asked is minimum (a/A - s/S = maximum). This value also indicates the extent of the separation between the two phases. For example, if all the analytic questions had already occurred before a specific point, (a/A = 100) and all the synthesis questions were still to be asked (s/S = 0), then the separation of the two phases would be perfect or 100. A less clear separation between the two phases would be indicated by a reduction of this maximum value. The clarity, or the value of this shift point, is thought to reflect the degree of organization inherent in the problem solving process. Tables 18 and 19 present analyses of these scores for Problems 3 and 2. There were no significant differences on this measure either as a function of level of anxiety, instruction conditions, or in their interactions.

The rate of asking questions (Number Q/T) has also been found to be an important dimension of the problem solving process. Tables 20 and 21 present these data for Problem 3 and Problem 2 respectively. In both Problem 3 and Problem 2 there were over-all anxiety differences

Table 18

Analysis-Synthesis Shift Value for Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	.627	.453	.578	.509
High Anxious	.527	.482	.457	.496
Total	.539	.454	.510	

	z	p
Anxiety Effect	.94	NS
Play	.79	NS
Evaluative	.07	NS
Neutral	.75	NS
Condition Effect (H test)	.21	NS
Within Groups:		
Low Anxious		
total (H test)	.35	NS
play-evaluative	.30	NS
play-neutral	.23	NS
High Anxious		
total (H test)	.14	NS
play-evaluative	.11	NS
play-neutral	.45	NS
Interaction:		
play-evaluative	.29	NS
play-neutral	.48	NS

Table 19

Analysis-Synthesis Shift Value for Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	.572	.585	.564	.572
High Anxious	.604	.660	.614	.608
Total	.587	.609	.590	

	z	p
Anxiety Effect	.64	NS
Play	.49	NS
Evaluative	.30	NS
Neutral	.45	NS
Condition Effect (H test)	1.08	NS
Within Groups:		
Low Anxious		
total (H test)	.98	NS
play-evaluative	-.65	NS
play-neutral	.30	NS
High Anxious		
total (H test)	.38	NS
play-evaluative	-.60	NS
play-neutral	-.23	NS
Interaction:		
play-evaluative	.04	NS
play-neutral	.37	NS

which indicated that high anxious subjects proceeded more rapidly than low anxious subjects. There were also indications in both problems that evaluative instructions seemed to have the effect of making subjects in both anxiety groups proceed more slowly. This was particularly noteworthy in Problem 3, where both high and low anxious subjects asked questions at a significantly slower rate in the evaluative than in the play condition.

Table 20

Total Rate for Problem 3

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	2.78	1.74	2.18	2.25
High Anxious	2.97	2.41	2.84	2.69
Total	2.83	2.09	2.57	

	z	p
Anxiety Effect	1.37	.09
Play	.26	NS
Evaluative	.94	NS
Neutral	1.21	NS
Condition Effect (H test)	4.41	NS
Within Groups:		
Low Anxious		
total (H test)	2.13	NS
play-evaluative	1.59	.06
play-neutral	.53	NS
High Anxious		
total (H test)	3.66	NS
play-evaluative	1.70	.05
play-neutral	.08	NS
Interaction:		
play-evaluative	.08	NS
play-neutral	.43	NS

Table 21

Total Rate for Problem 2

	Median			
	Play	Evaluative	Neutral	Total
Low Anxious	2.5	2.49	3.04	2.66
High Anxious	3.16	3.12	3.30	3.16
Total	2.90	2.66	3.26	

	z	p
Anxiety Effect	1.94	.03
Play	1.51	.07
Evaluative	1.06	NS
Neutral	.60	NS
Condition Effect (H test)	1.04	NS
Within Groups:		
Low Anxious		
total (H test)	.23	NS
play-evaluative	0	NS
play-neutral	-.15	NS
High Anxious		
total (H test)	.84	NS
play-evaluative	.83	NS
play-neutral	.45	NS
Interaction:		
play-evaluative	.59	NS
play-neutral	.43	NS

DISCUSSION

The results of the present study can be organized into two major categories: I) differences in problem solving performance of high and low anxious subjects, and II) the effects of instruction conditions upon the problem solving performance of high and low anxious subjects.

In terms of the relative efficiency of high and low anxious subjects, the results indicated that low anxious subjects were consistently more efficient than high anxious subjects. This difference between anxiety groups was most noteworthy on the first of the three problems used in the study. Though it was not possible to test statistically whether the degree of difference between high and low anxious subjects was any greater on the first problem than on the subsequent two problems, the data clearly indicated a trend in this direction. Since Problem 1 was by far the easiest problem in the series, this trend suggested that it was the initial adjustment to a situation, rather than the degree of complexity of a problem, which constituted a major difficulty for high anxious subjects. This conclusion received further support in the analyses of the relative degree of efficiency in the three phases of the problem solving process. The primary differences between high and low anxious subjects occurred in the initial phase of the problem solving process. It was in this phase that the low anxious group was usually significantly more efficient than the high anxious group. The high and low anxiety groups did not differ significantly in their efficiency during the latter stages of the problem solving process, during the lag and synthesis phases. Thus,

even within a single problem, it was the initial phase that differentiated the high and low anxious groups. It was the initial adaptation to a situation or to a new problem that seemed to present a major difficulty for high anxious subjects.

In comparing the characteristics of efficiency of high and low anxious subjects, it was apparent that the difference in level of efficiency of the two groups was primarily a function of high anxious subjects asking more redundant questions. Both on an absolute basis and in comparison to the degree to which unique unnecessary questions were asked, high anxious subjects were significantly more redundant than low anxious subjects. Since redundant questions were those which had been explicitly asked before and were asked once again, it seems that the inefficiency of high anxious subjects, as compared to low anxious subjects, could be characterized as more rigid rather than diffuse and fluid. This type of inefficiency (redundancy) generally served to establish feelings of certainty and confidence rather than being in the service of exploring new leads and possibilities.

High anxious subjects also asked questions at a significantly faster rate than did low anxious subjects. Even though high anxious subjects took more time to solve the problem than low anxious subjects, they asked questions at a faster rate. Low anxious subjects may have been attending more carefully to the implications and purposes of each of their questions while solving the problem, whereas high anxious subjects may not have been able to tolerate the delay essential for more efficient functioning.

The degree of organization of a subject's problem solving process, as expressed in the analysis-synthesis shift score, has been found in

prior research to be positively and significantly related to estimates of creativity and cognitive efficiency (Blatt & Stein, 1959). It is important to note that in the present study there were no significant differences between high and low anxious subjects on this measure. Though high anxious subjects asked significantly more redundant questions than low anxious subjects and therefore were less efficient, the organization of the thought processes of subjects in these two groups did not seem to be significantly different. This finding, along with the finding that heightened anxiety had its most detrimental effects in the early adaptation to a situation or problem, suggested that the effects of high anxiety on problem solving seen in the current study may be transitory. In fact, the data suggested that even within a single problem, high and low anxious subjects were not significantly different in the later stages of the problem solving process.

The difference between anxiety groups seemed to diminish as subjects became more familiar with the experimental situation and with each specific problem. The fact that the differences in level of efficiency of high and low anxious subjects occurred primarily in the first problem of the experiment and in the initial phase of each of the problems suggested that the detrimental effect of anxiety on cognitive processes was in the relative disruption of the initial adaptation of high anxious subjects to an unknown situation. As high anxious subjects become more familiar with the situation and the specific problem, come to understand the demands and expectations, and begin to develop feelings of confidence, the differences between high and low anxious subjects could greatly diminish. The finding that anxiety had its primary disruptive effects in the initial adaptation and the fact

that there were no significant differences in academic grades between high and low anxious groups suggest that in situations where high anxious subjects are given time to accommodate and to become familiar with a situation, they may be able to function as effectively as low anxious subjects. It would be of interest, therefore, to test high and low anxious subjects over an extended period, such as over several days, to see if the differences in cognitive efficiency diminish over time. In fact, high anxious subjects might even exceed low anxious subjects in testing which extended over several days because of greater persistence. This quality of persistence in high anxious subjects was suggested by the significantly higher proportion of redundant questions in their inefficiency and by the significantly faster rate at which they performed.

In the analysis of the effects of instruction conditions there were no significant total between condition effects on any measure of the problem solving pr . As seen in the interactions with anxiety, condition of instructions seemed to have some effect, but considered as a total effect there was no support for the over-all efficacy of one type of instruction as compared to others. There were some suggestions both in the data from Problem 3 and from Problem 2 that high anxious subjects in the play condition tended to be more efficient than high anxious subjects in the neutral or evaluative conditions. This effect, however, never reached statistical significance. Also, in all three conditions, high anxious subjects were generally less efficient than low anxious subjects. This trend toward a facilitation of the problem solving process of high anxious subjects by play conditions in the later and more difficult problems was in marked contrast

to the highly significant detrimental effect that play instructions had for high anxious subjects on the first problem. High anxious subjects in the play condition on Problem 1 were significantly less efficient than high anxious subjects in other conditions and significantly less efficient than low anxious subjects in the play condition. Thus on the first problem, where high anxious subjects were most inefficient as compared to low anxious subjects, it was in the play instructions that this difference was exaggerated. It was only in the later problems that the play condition appeared to have some facilitative effect on high anxious subjects.

Of the three phases of the problem solving process, it was primarily within the initial phase of the problem that instruction conditions seemed to have a noticeable effect. In Problem 3, the play condition clearly facilitated the level of efficiency of low anxious subjects in the initial phase. The neutral condition appeared to have the opposite effect for low anxious subjects and it was in this condition that low anxious subjects tended to be less efficient than high anxious subjects during the initial phase. In the lag and synthesis phases of Problem 3, instruction conditions appeared to have little effect on the efficiency of both high and low anxious subjects.

In Problem 2, the effects of instruction conditions were more significant and striking. On this problem as on Problem 3, the effects of instruction conditions were exclusively limited to the initial phase. Play facilitated the initial efficiency of low anxious subjects both in comparison to high anxious subjects under the same condit on and in comparison to low anxious subjects under the other two conditions. In the high anxious group, on the other hand, it was the

evaluative condition which seemed to facilitate initial efficiency when compared to the performance of high anxious subjects under the other two conditions.

In the first problem, low anxious subjects in the play condition were significantly more efficient than high anxious subjects who were given the same instructions. In contrast, the evaluative condition facilitated the efficiency of high anxious subjects as compared to the other two instruction conditions. These results were very similar to the condition effects noted in the initial phase of Problems 3 and 2. Thus, both within the total experiment and within each problem, high anxious subjects appeared to be initially facilitated by the evaluative condition. This was in contrast to low anxious subjects who seemed to find the play condition more favorable for initial functioning. In contrast to the initial effects, variations in instruction conditions appeared to have little effect on the performance in subsequent phases of the problem solving process. In fact, the effect of instruction variations seemed to diminish in the initial phase of the last problem.

Instruction conditions appeared to have relatively little effect upon the type of inefficient questions subjects asked. Neither the number of redundant nor the number of unique unnecessary questions asked by high and low anxious subjects in Problems 3 and 2 related significantly to instruction conditions. There was a significant play-evaluative difference, however, in the unique to redundant ratio on Problem 2 for high anxious subjects. The evaluative condition in Problem 2 seemed to enable high anxious subjects to ask a greater proportion of unique questions than high anxious subjects in the other two conditions. This is consistent with the finding that the evaluative

condition generally tended to facilitate the functioning of high anxious subjects on the earlier problems.

The evaluative condition appeared to also have the effect of enabling subjects to proceed at a slower rate. On Problem 3, both high and low anxious subjects asked questions at a significantly slower rate than subjects in the other two conditions. Though not significant, a similar trend was observed on Problem 2. It seems that one aspect of the facilitative effect of the evaluative condition for high anxious subjects may be the tendency to induce caution and encourage careful work rather than supporting or encouraging a rapid and less thoughtful search for solution.

Though the results of the present study supported the hypotheses about the differences in cognitive efficiency of high and low anxious subjects, the hypotheses about the effects of instruction conditions on the problem solving of high and low anxious subjects were generally not supported. The performance of high anxious subjects did not seem to be any more influenced by instruction variations than the performance of low anxious subjects. The evaluative condition did not seem to produce a greater difference between the level of efficiency of high anxious and low anxious subjects than did the other two instruction conditions and the hypothesized facilitation of high anxious subjects by playful instructions was not statistically significant, though there were trends in this direction. An interesting but unexpected finding was the marked facilitating effect that play instructions had on the initial efficiency of low anxious subjects. While playful instructions, as compared to the other two conditions, tended to facilitate the over-all efficiency of high anxious subjects in later problems,

play instructions were significantly disruptive for high anxious subjects, as compared to low anxious subjects, both in the first problem and in the initial phase of the latter two problems.

If high anxious subjects are in fact very apprehensive as they approach a new task, play instructions must seem contradictory and confusing. Problem solving in an experimental situation, regardless of attempts to present it differently, can still be perceived as a test. The decrease in the initial efficiency of high anxious subjects under play conditions suggests that the incongruity of the play instructions may have had the initial effect of making high anxious subjects all the more apprehensive.

The cognitive functioning of high anxious subjects seemed more facilitated by familiarity with the situation and with the task than by any variations of instructions. Thus the data supported the hypothesis that disruptive effects of anxiety on cognition may be exaggerated by the initial apprehension of the high anxious subjects. The disruptive effects of anxiety may well be transitory and therefore may markedly diminish as high anxious subjects become more familiar with the situation.

Summary

Approximately three hundred male undergraduate students in introductory psychology sections were given the Sarason-Mandler Test Anxiety Scale and the upper and lower 10% of the distribution were selected for study. These subjects were contacted subsequently and told that they were part of a random sample of students selected for a study of problem solving. All sixty subjects agreed to participate and ten subjects from each of the anxiety groups were randomly assigned to one of three instruction groups, either play, evaluative or neutral instruction conditions.

Evaluative instructions emphasized the scientific precision of the problem solving apparatus in the study of creativity and that the design of the experiment was to compare Yale students with national norms. Ss were told that their performance would be recorded by an observer behind a one-way observation window. The subjects in the neutral group were given the instructions for the problem solving task with no attempt to place it in any specific context. The playful exploration group was told that the problem solving apparatus was a gadget that a few people around campus had just built. We had a great deal of fun building it, but did not know if it had any value and therefore wanted a group of students to play around with it, try some problems and tell us what they thought about it. In both the neutral and playful conditions the one-way observation mirrors were covered by curtains.

The experimenter was present during Problem 1, since it is the problem on which instructions are given. During Problem 2 and 3, however, the experimenter left the room and subjects in the neutral

and play conditions were told that the experimenter was in another office down the hall and that the subject should call for the experimenter when he was finished with the problem. The only time the experimenter came to the experimental room was when a subject exceeded the established time limit.

All subjects were studied individually on the John-Rimoldi PSI and given three standard problems. The first of three problems is relatively simple and is used to demonstrate the apparatus. The second problem, though somewhat more complex than the first, is only moderately difficult and it is used to insure the experimenter that the instructions have been full understood. The third problem is the experimental problem and is considerably more complex than the first two problems. The level of a subject's problem solving efficiency was obtained for all three problems. In the second and third problems the degree of efficiency for each of the phases of the problem solving process was obtained as well as the nature and characteristics of the total inefficiency.

The primary findings of the study were the differences in the problem solving of high and low anxious subjects. Low anxious subjects were consistently more efficient than high anxious subjects. This difference between the two anxiety groups was most marked on the first problem of the experiement. Since problem 1 was by far the easiest problem in the series, this trend suggested that it was the initial adjustment to a situation, rather than the degree of complexity, which constituted a major difficulty for high anxious subjects. This conclusion received further support in the analyses of the relative degree of efficiency in the three phases

of the problem solving process. The primary differences between high and low anxious subjects occurred in the initial phase of the problem solving process. It was in this phase that the low anxious group was usually significantly more efficient than the high anxious group. The high and low anxiety groups did not differ significantly in their efficiency during the latter stages of the problem solving process, during the lag and synthesis phases. Thus, even within a single problem, it was the initial phase that differentiated the high and low anxious groups. It was the initial adaptation to a situation or to a new problem that seemed to present a major difficulty for high anxious subjects.

Though the results of the present study supported the hypotheses about the differences in cognitive efficiency of high and low anxious subjects, the hypotheses about the effects of instruction conditions on the problem solving of high and low anxious subjects were generally not supported. The performance of high anxious subjects did not seem to be any more influenced by instruction variations than the performance of low anxious subjects. The evaluative condition did not seem to produce a greater difference between the level of efficiency of high anxious and low anxious subjects than did the other two instruction conditions and the hypothesized facilitation of high anxious subjects by playful instructions was not statistically significant, though there were trends in this direction. An interesting but unexpected finding was the marked facilitating effect that play instructions had on the initial efficiency of low anxious subjects. While playful instructions, as compared to the other two conditions, tended to

facilitate the over-all efficiency of high anxious subjects in later problems, play instructions were significantly disruptive for high anxious subjects, as compared to low anxious subjects, both in the first problem and in the initial phase of the latter two problems.

The cognitive functioning of high anxious subjects seemed more facilitated by familiarity with the situation and with the task than by any variations of instructions. The data supported the hypothesis that disruptive effects of anxiety on cognition may be exaggerated by the initial apprehension of the high anxious subjects. The disruptive effects of anxiety observed in the present study may well be transitory and may diminish markedly as high anxious subjects become more familiar with a situation.

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APPENDIX

Table 1.

Median College Entrance Examination Boards Scores

	Verbal Scores		
	Play	Evaluative	Neutral
Low Anxious	665	618	646
High Anxious	668	644	586

Low Anxious - High Anxious Difference Z= .97, N.S.

Condition Difference H= 3.80, N.S.

	Mathematics Scores		
	Play	Evaluative	Neutral
Low Anxious	684	764	664
High Anxious	670	666	675

Low Anxious - High Anxious Difference Z= 2.10, < .02

Condition Difference H= .08, N.S.

Table 2

Correlations of Efficiency on Experimental Problem with other estimates of Cognitive Efficiency

	Low Anxious	High Anxious	Total
C E E B			
Verbal (N = 30,29)	.66**	.25	.38**
Math (N = 30,29)	.47**	.47**	.47**
Predicted College Average [a] (N = 29,29)	.46**	.34*	.44**
College Grades (Rank in class)			
Freshman (N = 30,30)	.35*	-.10	.24*
Sophomore (N = 21,23)	.53**	.01	.38**
Junior (N = 10,7)	.83**	-.61	.50

* = .05

** = .01

[a] The predicted college average is based on College Entrance Examination Board scores, high school grades and the quality of the high school.

Table 3

Correlations of Predicted College Average with College Grades

	Low Anxious	High Anxious	Total
Freshman (N = 29, 29)	.55**	.37*	.43**
Sophomore (N= 21, 22)	.63**	.44*	.55**
Juniors (N = 10, 6)	.74*	.31	.62**

* = .05

** = .01

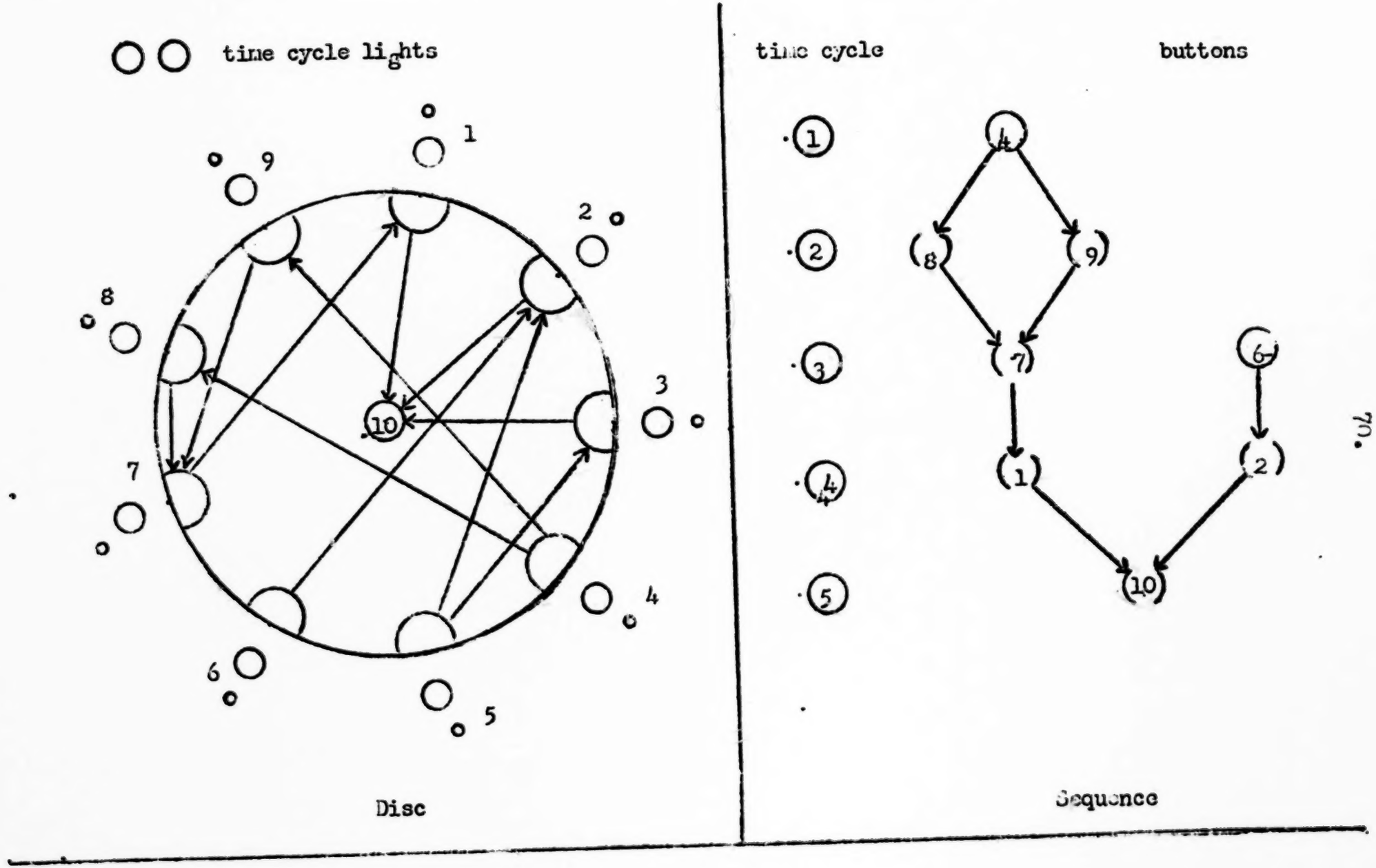

Figure 1

Diagrammatic Representation of the Disc and the Sequence to the Solution for the Demonstration Problem